Does speculation drive agricultural commodity spot prices?

Treibt Spekulation agrarische Kassapreise?

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Summary

There are widespread beliefs that speculation with agricultural commodities on the futures market has led to rising agricultural commodity spot prices. We empirically analyse the causal relationships between spot prices of maize, wheat, rice, and soybean and agricultural commodity futures trading activities. Theoretical linkages are discussed and relationships between spot prices and financial variables are tested for Granger-causality. Hardly any empirical evidence for causal relationships have been found between changes in "volume traded" and "open positions" of futures contracts and changes in spot prices. The lack of empirical findings casts considerable doubt on the belief that speculation is a major driver of rising agricultural commodity prices.

Keywords: Agricultural commodities, futures markets, hedging, speculation, Granger-causality test

Zusammenfassung

Es besteht die weit verbreitete Meinung, dass Spekulation mit Agrarrohstoffen an Terminmärkten zu erheblichen Steigerungen der Kassapreise geführt hat. Diese Arbeit untersucht empirisch die kausalen Beziehungen zwischen Kassapreisen und Finanzhandelsaktivitäten. In einem ersten Schritt werden die theoretischen Grundlagen von Kassa- und Warenterminmärkten erklärt. Anschließend werden die Kassapreise von Mais, Weizen, Reis und Soja und die Finanzvariablen „volume traded" und „open positions" empirisch auf Granger-Kausalität getestet. Aus der Literatur

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können wenige theoretische Beziehungen zwischen den Kassapreisen und Finanzhandelsaktivitäten erklärt werden. Die empirischen Testergebnisse weisen kaum kausale Zusammenhänge auf. Die Erkenntnisse lassen Zweifel an der Annahme aufkommen, dass Spekulation mit Agrarrohstoffen am Terminmarkt einen signifikanten Einfluss auf die Kassapreise von Agrarrohstoffen hat.
Schlagworte: Agrarrohstoffe, Terminmärkte, Hedging, Spekulation, Granger-Kausalitäten Test

1. Introduction

What has driven up food prices during the years 2007-2008 and 2011? Different assumptions exist and try to explore this question (compare literature reviews by WILL et al., 2012; GILBERT and PFUDERER, 2013). Some argue that the extreme rise in food prices on the spot market is fairly explained by market fundamentals of demand and supply such as a strong demand from China, the growing bio-energy production, supply shortfalls, or monetary policies. Others respond that disruptive non-fundamental drivers – trading activities with futures by financial market participants – are responsible for soaring agricultural commodity spot prices. Speculation with agricultural commodity futures is often blamed to be the major driver for increasing (or decreasing) spot prices by politicians and the public. Thus, we empirically investigate the causal relationships between spot prices and futures trading activities.

Basically, there are two groups of participants on futures markets with different objectives. One group are commercial traders (hedgers) such as producers, processors, and wholesalers, who aim to reduce price risks associated with selling or buying a physical commodity. The other group are non-commercial traders (speculators), who are willing to take price risks and provide liquidity in the expectancy of profits (HULL, 2002; CFTC, 2012).

Some researchers such as GILBERT (2010) argue that agricultural commodity futures positions held by the relatively new group of commodity index investors possibly led to increasing food prices in 2007-2008. Financial investors in the context of commodity index investments most frequently take positions through long-only index funds (IRWIN and SANDERS, 2011a). Going “long” describes the situation where the holder of an asset (e.g. futures contract) profits from rising prices of the asset, whereas going "short" describes the situation where the holder of an asset profits from decreasing prices of the asset (PEIRSON, 2008). In recent years, index-based investments have shown a rapid growth, hence a strong rising demand for futures positions. Between the years 2004-2008, about $ 100 billion of new investments flew into commodity futures markets, a process that is often called "financialization" of agricultural markets (IRWIN and SANDERS, 2011a).

However, there are some theoretical inconsistencies in the arguments that increasing trading activity leads to increasing spot prices. A major one is that of equating the demand for futures positions (i.e. money inflow) with the demand for the physical commodity. Long positions are not considered to be a new demand as short positions are not a new supply of the physical commodity. There is a long for every short position such that futures markets are a zero-sum game (PEIRSON, 2008; IRWIN and SANDERS, 2011a). Money flows on futures markets do not necessarily impact prices, and any theoretical relationship is unclear at best (IRWIN and SANDERS, 2011a).

Therefore, we empirically test whether changes in long futures positions of hedgers and speculators are causal for changes in the particular commodity spot price and vice versa.

The rest of this paper is structured as follows. The next section discusses the theoretical linkages of spot and futures markets. Then, the third section explains the data and the empirical method used in this analysis. Empirical results obtained are presented in the fourth section. The fifth section analyses and discusses the results. Finally, the paper is summarized and a conclusion is given.

2. Theory

Price discovery on spot markets is based on physical demand and supply factors, and a multitude of information is available (COLMAN and YOUNG, 1989; TOMEK and ROBINSON, 2003). Furthermore, a big number of independent agents make decisions according to their own preferences. Price formation of commodities on futures markets (the market for a commodity with delivery in the future) is based on information about demand, supply, and inventory. A buyer, for instance, has the possibility either to buy grains on the spot market today and store the grains until they are needed or buy a futures contract and wait until delivery of the commodity (compare example for hedging based on PEIRSON, 2008, 545). It is important to highlight that the buyer on the spot market faces storage costs and opportunity costs (UNCTAD, 2011).

The price difference between a futures price and the spot price of the futures contract underlying physical commodity is called basis. The basis is fairly explained by the *theory of storage* (HULL, 2002) by opportunity costs, storage costs, and convenience yields. According to BAILEY (2005, 379), "the futures price reflects expectations about the spot price of the underlying asset at its delivery date". For example, as long as the spot price plus carrying costs exceed (or are at least equal to) the futures price, no arbitrage opportunity may be given. If the futures price exceeds the spot price plus carrying costs, market participants may buy the commodity on the spot market today and go short on the futures market simultaneously (sell a futures contract for the higher price). Note that only market participants in the physical commodity business (commercial traders) may be able to trade in this way as it requires physical storage capabilities. Market participants follow this procedure until spot prices plus carrying costs are at least the futures price (UNCTAD, 2011). If the futures price is less than the spot price plus carrying costs, an arbitrage opportunity is given as well. The commodity is sold on the spot market by market participants and immediately bought on the futures market (going long). They do so until spot prices plus carrying costs are at least the futures price.

However, since we test spot prices and futures trading activities (and *not* futures prices) for bi-directional Granger-causality, the *theory of storage* is not a sufficient theoretical basis. The empirical relationships between spot prices *and* futures prices are not part of the research. In previous studies, the focus was given to futures prices (e.g. IRWIN and SANDERS, 2011b). The role of information was considered in order to explain its development mechanism. According to the *efficient market hypothesis*, price changes should follow a random walk process and "all currently available information of any relevance in evaluating the asset in question is already incorporated in the market price" (HENS and SCHENK-HOPPÉ, 2009, 165). In contrast, "financialization" describes the circumstance of increasing investments of "hedge funds, commodity index funds and investment banks" in commodity derivates according to SCHULMEISTER (2012, 3). He argues that "the widely used trend-following trading techniques cause commodity prices to move in a sequence of long-term upward and downward trends, overshooting their fundamental equilibrium in both directions" (ibid.). Beside market fundamentals (i.e., supply and demand), also "destabilizing speculation" (ibid., 4) may drive prices. Thus, the purpose of our study is to empirically test for causal relationships between agricultural commodity spot prices and futures trading activities. However, only very weak theoretical approaches have been found for a causal relationship between agricultural commodity spot prices and futures trading activities.

3. Data and Method

Agricultural commodity spot price data for maize, wheat, rice and soybean prices are available from FAO (2011). These three cereals plus soybean are chosen as their prices rose tremendously in recent years. Also, their internationally traded volume (in tonnes) is among the highest. Four futures positions data series have been used for each commodity: open interest data (long positions of commercials, long positions of non-commercials, total reportable positions) and volume traded at the Chicago Board of Trade (CBOT) from CFTC (2011). According to CFTC (2012) "open interest is the total of all futures and/or option contracts entered into and not yet offset (…). The aggregate of all long open interest is equal to the aggregate of all short open interest." Besides open interest (or open positions) the volume traded gives the whole amount of contracts bought and sold over a certain period of time, e.g. traded volume per day. The volume traded offers information about market liquidity (HULL, 2002).

All data are available on a monthly basis. Time series start in January 2002 and end in May 2011 providing 113 observation points. The data mainly describe the situation in the US. All data have been logarithmized. Granger-causality tests have been conducted in a multivariate framework to test causal relationships between time series. This test framework was used since Granger-causality tests represent state of the art practice to test for causalities between time series variables.

Our econometric procedure follows LÜTKEPOHL and KRÄTZIG (2004). In the case of two time series, X_1 and X_2, X_1 Granger-causes X_2 if X_2 can be better predicted using the histories of both X_1 and X_2 than using histories of X_2 alone. In particular, X_2 is not Granger-causal for X_1 if the bi-variate VAR(p) process of the form

$$\begin{bmatrix} X_{1,t} \\ X_{2,t} \end{bmatrix} = \sum_{i=1}^{p} \begin{bmatrix} \gamma_{11,i} & \gamma_{12,i} \\ \gamma_{21,i} & \gamma_{22,i} \end{bmatrix} \begin{bmatrix} X_{1,t-i} \\ X_{2,t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix} \quad (1)$$

has $\gamma_{12,i} = 0$, for all $i = 1,2,\ldots,p$. It requires checking whether specific coefficients are zero, therefore standard tests for zero restrictions are applied (F-test). The null hypothesis in the test is no Granger-causality. Since Granger-causality tests are incorrect in the presence of non-stationarity in the time series data, the procedure of TODA and YAMAMOTO (1995) has been applied. Consequently, a vector autoregressive (VAR) process has been fitted whose order exceeds the true order with additional lags equal to the maximum order of integration. Thus, we test time series for unit roots and the order of integration by applying Augmented Dickey-Fuller (ADF) tests. Each commodity is subject to four hypotheses (position data Granger-cause price) and delivers eight results, as the Granger-causality procedure tests for (possible) bi-directional relationships.

4. Results

Table 1 shows the tested Granger-causality relations. The arrows indicate significant Granger-causality between particular data series. The tests mostly failed to reject the null hypotheses at the 5% significance level. Merely six out of 32 hypotheses (we tested 16 hypotheses bi-directionally) are rejected and only one is associated with the question of a causal relationship from trading activities to spot prices. Four out of six rejected null hypotheses are associated with maize, one with soybean, and one with rice. None of the hypotheses for wheat are rejected. In addition, see table 1 for detailed p-values of the Granger-causality test. Arrows (←/→) indicate the direction of Granger-causality. For example, the null hypothesis (H_0) for maize (→), "maize spot prices do not Granger-cause commercial long positions on maize", was rejected. However, Granger-causality test of the vice-versa null-hypothesis (H_0') for maize (←), "commercial long positions on maize do not Granger-cause spot price maize", failed to reject the H_0'. Overall findings indicate only rather weak evidence for Granger-causal relationships.

Tab. 1: Granger-causality test results: p-values

Null-hypotheses	Direction of Granger-causality	Commercial Long	Non-commercial Long	Total reportable positions	Volume traded
Maize	→	<0.01*	0.62	<0.01*	0.02*
Maize	←	0.96	0.03*	0.20	0.15
Wheat	→	0.74	0.44	0.21	0.56
Wheat	←	0.84	0.09	0.64	0.67
Rice	→	0.84	0.58	0.63	<0.01*
Rice	←	0.21	0.58	0.25	0.76
Soybean	→	0.89	<0.01*	0.56	0.78
Soybean	←	0.38	0.53	0.94	0.77

Note: Single asterisk (*) denotes significance at the 5% level. A VAR model with a constant was used. The lag order was determined by using AIC. Additional lags were included (TODA and YAMAMOTO, 1995). Logarithms of data series were used.

Source: Own calculations

5. Discussion

The debate about the role of speculation in driving up food prices is a very controversial and emotional one. There are academic theories and various empirical studies about the issue available. Most of the findings have gone through a peer-review process and are published in sound scientific journals. Such as this study, the major part of these articles cannot deliver empirical evidence that speculation has led to rising spot prices (compare WILL et al., 2012). However, some empirical evidence on a linkage between trading activities by speculators and prices can be found, e.g. in GILBERT (2010). Furthermore, there are reports that either do not deliver any empirical tests (compare UNCTAD, 2011; SCHULMEISTER, 2012) or use non-standard statistical methods (compare COOKE and ROBLES, 2009; WILL et al., 2012). Often, such reports or discussion papers refer to each other mutually and have not gone through a peer-review process. Furthermore, as it appears in public discussions, there is no doubt that financial speculation is the major driver of rising commodity spot prices. Debates take place emotionally, as foodstuff is of everybody's concern. However, we have found that only out of 16 tests show Granger-causal relationship between financial trading activities and spot prices i.e. non-commercial long trading (speculative open interest) may Granger-cause maize spot price. There is, however, hardly an explanation why this should be the case only for corn and not for the other traded food commodities. In contrast, the remaining five rejected cases may weakly indicate that spot prices do Granger-cause futures market positions.

A direct link between financial trading activities and spot prices might be information. Price formation on the spot market may increasingly incorporate information about the futures market (not only futures prices, but also traded volume and open positions), which may be misleading. In addition, misinterpretation of information about futures trading may lead to deviated spot prices, as wrong information is incorporated in spot price discovery. The information about rising demand for futures contracts might be seen as a signal for rising physical demand by mistake. If position changes of futures market participants really drive prices in the long-run, then the well-functioning of futures markets is in question. In the case of valid empirical evidence that "destabilizing speculation" (SCHULMEISTER, 2012, 4) drives up or down agricultural commodity prices, regulatory steps may be considered. However, any irrational and harmful impact of agricultural futures markets on agricultural commodity spot prices is not clarified.

6. Summary and conclusions

We have found hardly any empirical evidence that financial trading activities on agricultural futures markets are Granger-causal for changes in spot prices. However, some weak evidence has been found that spot prices are Granger-causal for changes in long trading positions or volume traded. Market participants might react to changing prices in their positions, but not vice versa. If financial trading activities are a major driver of rising commodity prices, this causal linkage should be clearly detectable in the data. Therefore, the lack of empirical evidence for causal relationships between traded positions on futures markets and changes in spot prices calls for more cautious discussion when policy measures "against speculation" in agricultural commodity markets are requested, as their overall impact on spot price levels is vague. Rather, historical quantitative studies suggest that futures markets are associated with, and most likely caused, lower commodity price volatility (JACKS, 2007).

However, there is no doubt that overall agricultural price risks have risen particularly in recent years. Researchers and policy-makers should further empirically investigate causalities of fundamental market factors before limiting futures markets.

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